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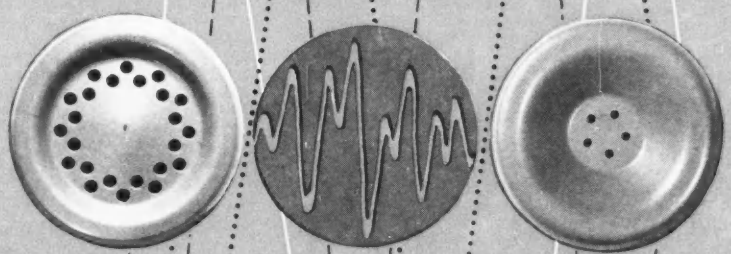
GENERAL TELEPHONE TECHNICAL JOURNAL

VOLUME 6 NO. 2



THE INQUIRING SPIRIT OF GENERAL TELEPHONE LABORATORIES page 34

GENERAL SYSTEM

SEPT. 1958 VOL. 6, NO. 2

GENERAL TELEPHONE TECHNICAL JOURNAL

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The General Telephone Technical Journal is published by General Telephone Laboratories, Incorporated, Northlake, Illinois.

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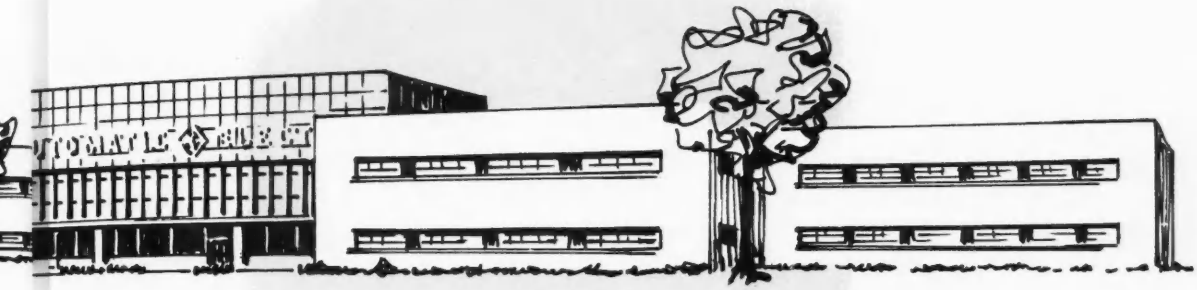


In this issue of the Journal, we've tried to show you what you would see if you were to visit our Laboratories.

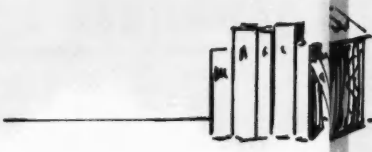
Of course, we'd like to have you actually visit us, here in our new quarters at Northlake, Illinois. We'd like nothing better than to sit down with you and share common problems and ideas; this is the kind of give-and-take that has been largely responsible for the progress of our industry. And we'd like to have you meet our people —we're *especially* proud of them.

But only a very few of all our friends are likely ever to visit us in person. That's why we have tried to bring the Laboratories to *you*. We hope the following pages will give you a better picture of General Telephone Laboratories, and of its work in the field of telecommunications.

Sincerely,

R. M. Wopat
President

THE INQUIRING SPIRIT E



One of the printed-circuit boards for an electronic switching system is here getting an oscilloscope check. The engineer is Leo Herbst, of the Memory Systems Section, Research Department, of the Laboratories.

ENERAL TELEPHONE LABORATORIES

General Telephone Laboratories was organized to ask questions—*and answer them.* Questions like, "What should be done?" "How can it be done?" "How can it be done *best?*"

These are simple, basic questions. But by asking them—*and then finding the answers*—the engineers of General Telephone Laboratories have made many pioneering contributions to modern telecommunications. The first "Strowger Automatic Telephone Exchange" is part of our heritage, and from that day to the present day of subscriber toll dialing and toll ticketing networks, this inquiring spirit has produced a constant flow of new developments in telecommunications. Our new building and its facilities, and the organization of the Laboratories itself—has been planned to give unlimited play to this inquiring spirit.

As the design and development organization associated with Automatic Electric Company, General Telephone Laboratories, Inc., serves General Telephone—largest Independent telephone system in the United States—and all the other users of Automatic Electric equipment. You might call us the "unofficial laboratory of the Independent telephone industry." Through the years, as automatic telephony spread among the Independents, telephone men acquired the habit of bringing their problems to Automatic Electric, and in this way initiated a great many of the major developments in dial telephony.

Laboratories brings together chemists, mathematicians, physicists, metallurgists, mechanical, electrical and electronics engineers, and others—each to contribute his specialized knowledge and skill. Such a "team" type of organization assures that

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many years of combined experience is brought to bear on each problem. And backing up this top-level development organization is a large staff of technicians—draftsmen, model makers and "life testers"—who put new ideas into practical form, and then assure their satisfactory operation.

General Telephone Laboratories is organized into three basic departments which reflect in general the three broad activities carried on: *Product Design*—the designing of new telephone instruments, switches, and other components that make up a telephone system; *Telephone Switching Systems*—development of telephone switching equipment ranging from the simplest of components to complex Strowger Automatic Toll Ticketing (SATT) systems; *Research*—providing fundamental information upon which the other two departments may be able to build.

General Telephone Laboratories shares this beautiful, big lobby with Automatic Electric and its other affiliated companies at Northlake.

You get an idea of great size when you look down the long corridors in the Laboratories. In the adjoining offices, teams of engineers are creating ideas which will set the pace for tomorrow's telecommunications.

The pleasant, yet businesslike, atmosphere of the Laboratories' reception room provides an appropriate introduction to its facilities and its people.

PRODUCT DESIGN

"Product Design" is a very broad term—so this department of the Laboratories embraces a wide range of activities. It includes, for example, the development and complete mechanical design of anything from the smallest part of a switch or relay to a complete line of telephone instruments. It is divided into several specialized "sections"—which regularly work together to complete design projects. In the design of the Type 80 Telephone, for example, the housing, with its smooth-flowing lines, easy-reading convex dial plate, and the "walking handset" feature, was developed in the Mechanical Design section, which was also responsible for the location and mounting of

The Laboratories' engineers usually work in teams, pooling their education and experience to solve each problem. Leader of this team of Product Design engineers, developing new telephone instruments, is F. E. Wood (second from right).

C. F. Ffolliott, head of the Product Design department of the Laboratories, tests a Type 80 telephone in the Anechoic Chamber. Note that the structure of sound-absorbing wedges extends below the Chamber "floor" which is actually a grid of stretched steel cables.

the various components within the housing. But before this work could proceed very far, another section, called Telephone Components, was required to work out the circuit for the new telephone, and the characteristics of the transmitter, receiver, etc., to be used in it.

For testing the characteristics of these and other acoustical components (e.g., ringers), Laboratories is provided with an Anechoic (echoless) Chamber of modern design. Its walls are seven feet thick, effectively sealing out practically all extraneous sounds, and all interior surfaces are covered with a sound-absorbing material in wedge shapes which minimize sound reflections. In this chamber, virtually all sounds above 100 cycles frequency are absorbed; there is slight reflection of lower frequencies—which are, however, of slight importance in telephone transmission.

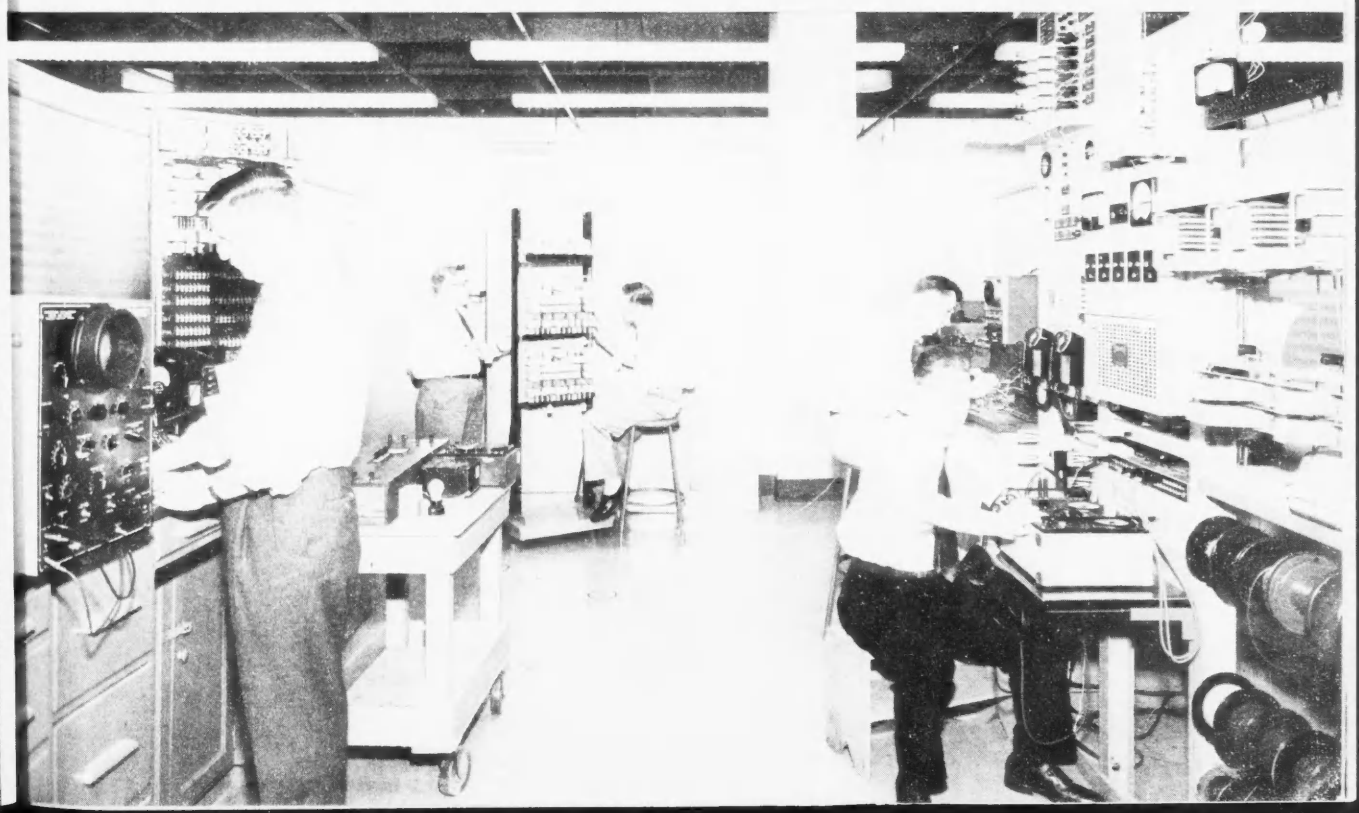
To apply electronics in new ways in telephony, we have the Electronics section in Product Design—which recently developed a unique Mobile Dial Radio System (see TJ-5-58) and a Negative-Impedance Voice Repeater using transistors to achieve new compactness and flexibility.

Other sections in Product Design include specialists in Power and Signaling, Teletypewriter Switching, and Industrial Design. This last-named section developed our wide line of Recorder-Announcers, the Loud-Speaking Telephone, and a new extrusion process for insulating wire; you will be interested to know that it is now developing techniques for the production of printed circuits, which will permit great reductions in size of telephone equipment in years to come.

Under the direction of R. P. Dimmer, the Electronics section in Product Design develops practical applications of electronics in telecommunications. E. Roback, a member of this section, is shown checking a negative-impedance voice repeater on the oscilloscope.

The Automatic Time Announcer, and many types of Recorder-Announcers, are among the developments of this section of Product Design engineers, under the direction of E. S. Peterson (center, wearing coat). Also, techniques for printing circuit boards, as R. O. Stoehr is doing in right foreground.

This is the Power and Signaling section of Product Design, headed by O. D. Grandstaff (shown, left rear). Composite Signaling equipment, a 1000-cycle Test Tone Generator and Single-Frequency Signaling are some of the projects here shown under development.

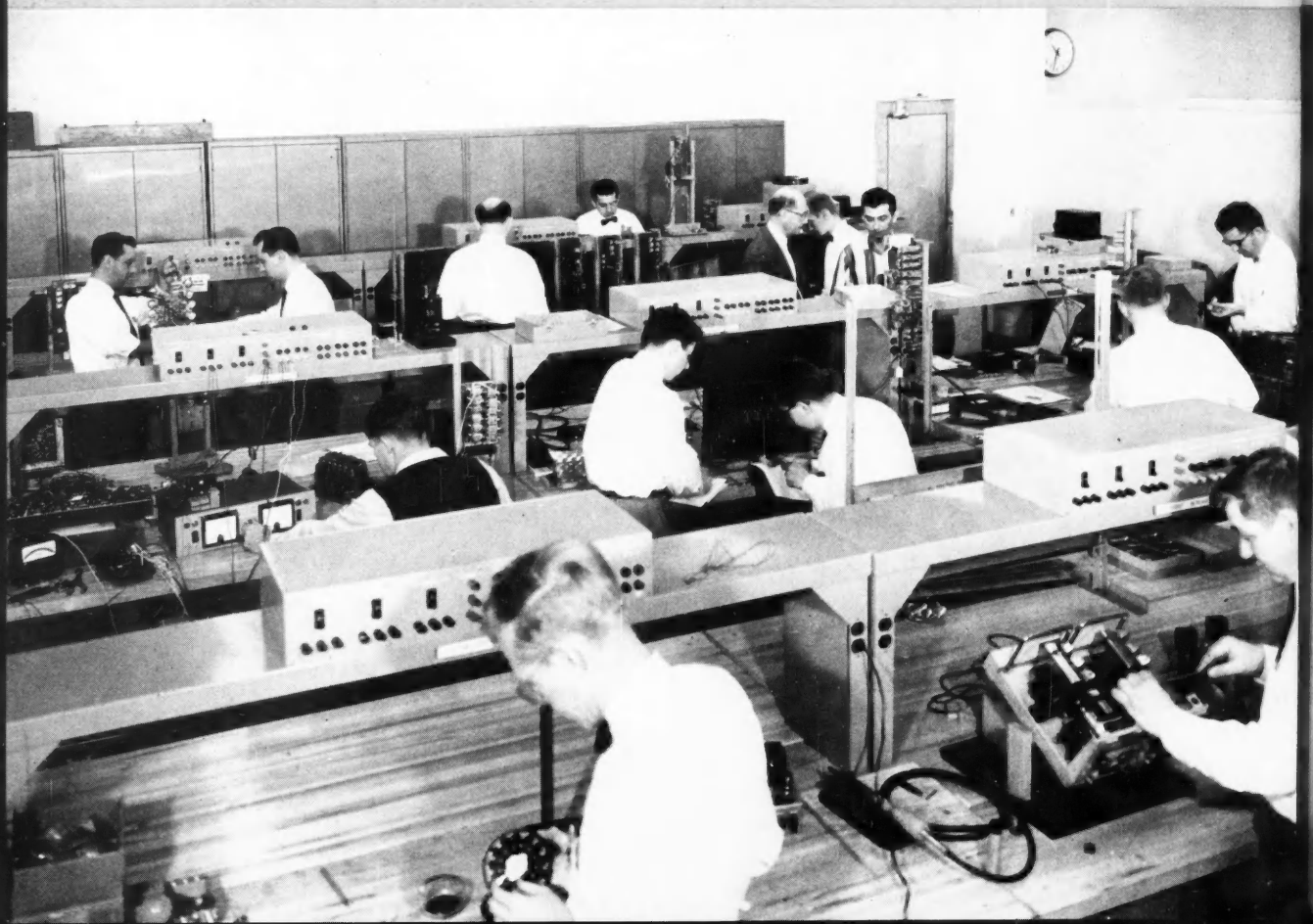


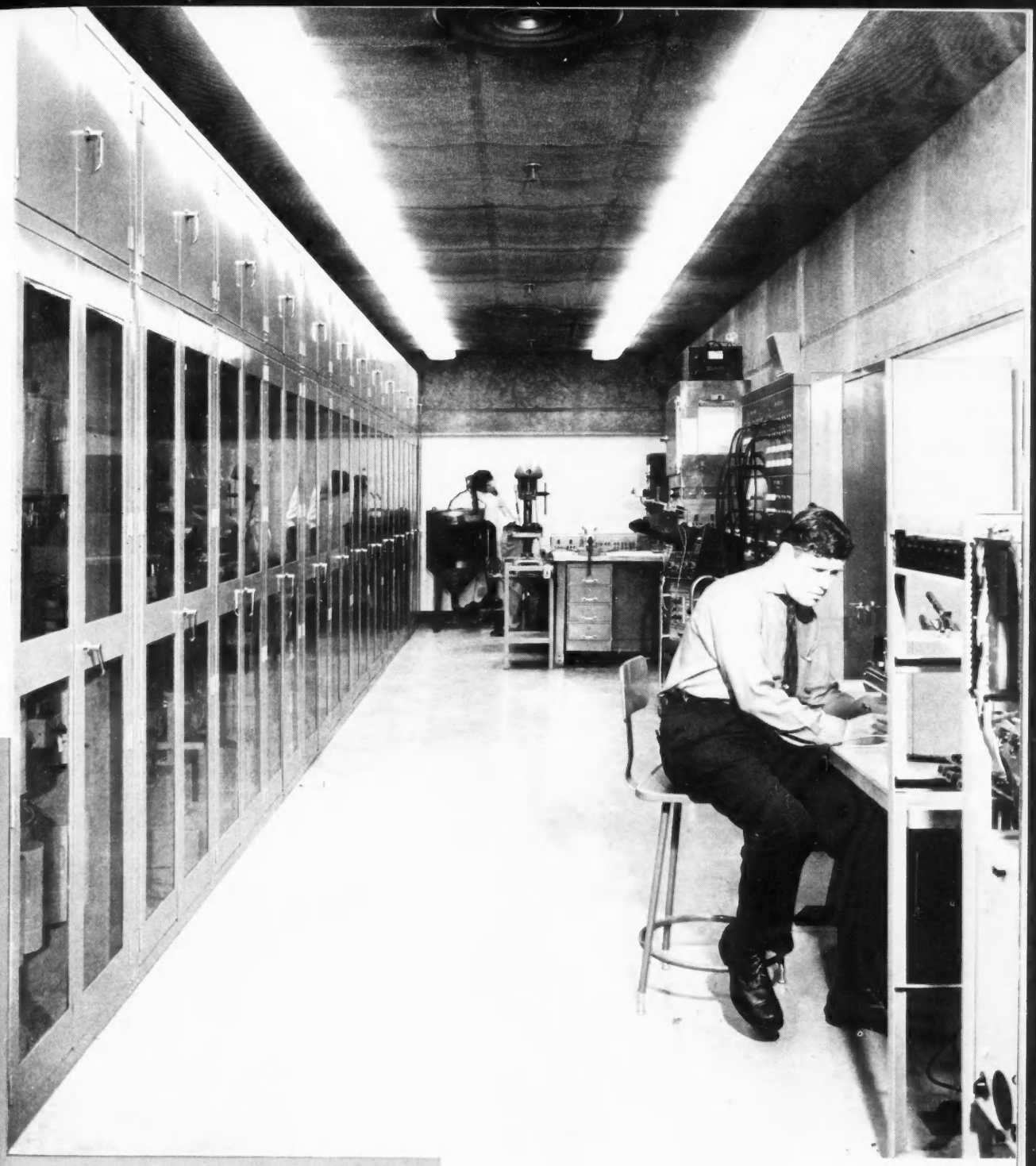
The Mechanical and Electrical Testing section performs tests of new circuits and product designs. Beside this, a particularly interesting part of its activities is "Life Testing"—which includes testing existing products to see how they might be improved. Some of these tests take many months; for example, Automatic Electric dials regularly run through three million five hundred thousand operations—which takes three and one-half months at the accelerated pace of the test, and corresponds to one hundred years of service on an average telephone!

Because many of these tests are quite noisy, the walls, ceiling and doors of the Life Test room are covered with sound-absorbing material. Special equipment includes a vibrating machine (mounted on a concrete pier, entirely separate from the laboratory floor) which makes vibration tests at speeds up to 1000 cycles per second; also, humidity cabinets that make it possible to subject equipment to a wide range of humidity, salt air, and temperature tests. New materials and finishes adopted as a result of such tests have greatly lengthened the life of equipment under adverse conditions.

Special testing apparatus, built in the Laboratories, is an important part of its equipment. This includes interval timers, "percent-make" pulse speed test sets, electronic and mechanical pulse generators, and dial testers. Other test devices are continually being developed—such as one machine recently designed to test plastic-covered cordage under typical operating conditions.

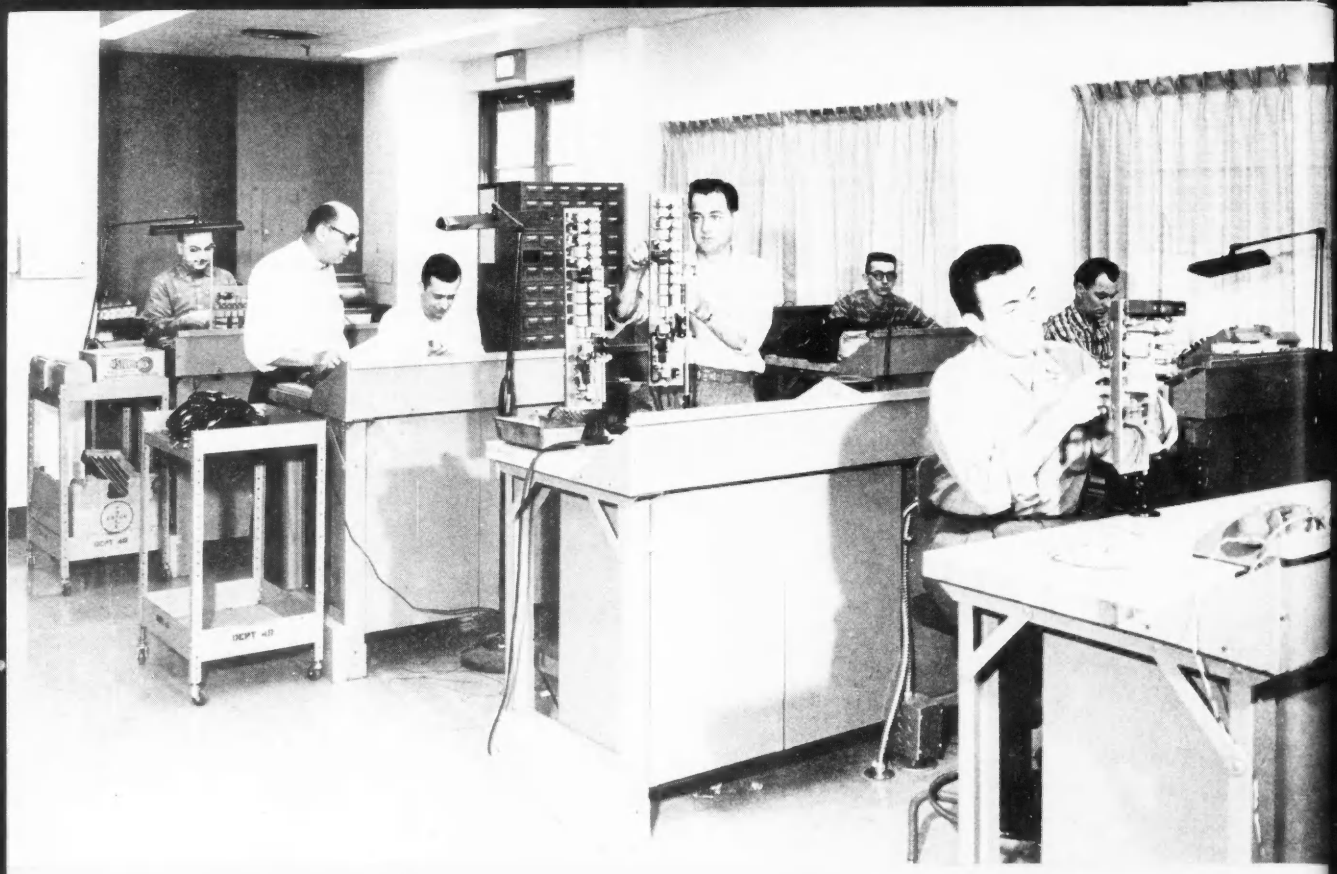
Outside the Life Test room, test circuit engineers are engaged in testing circuit arrangements for operational performance at the request of circuit engineers, or others. These tests are usually performed on special workbenches, arranged to provide power, ringing





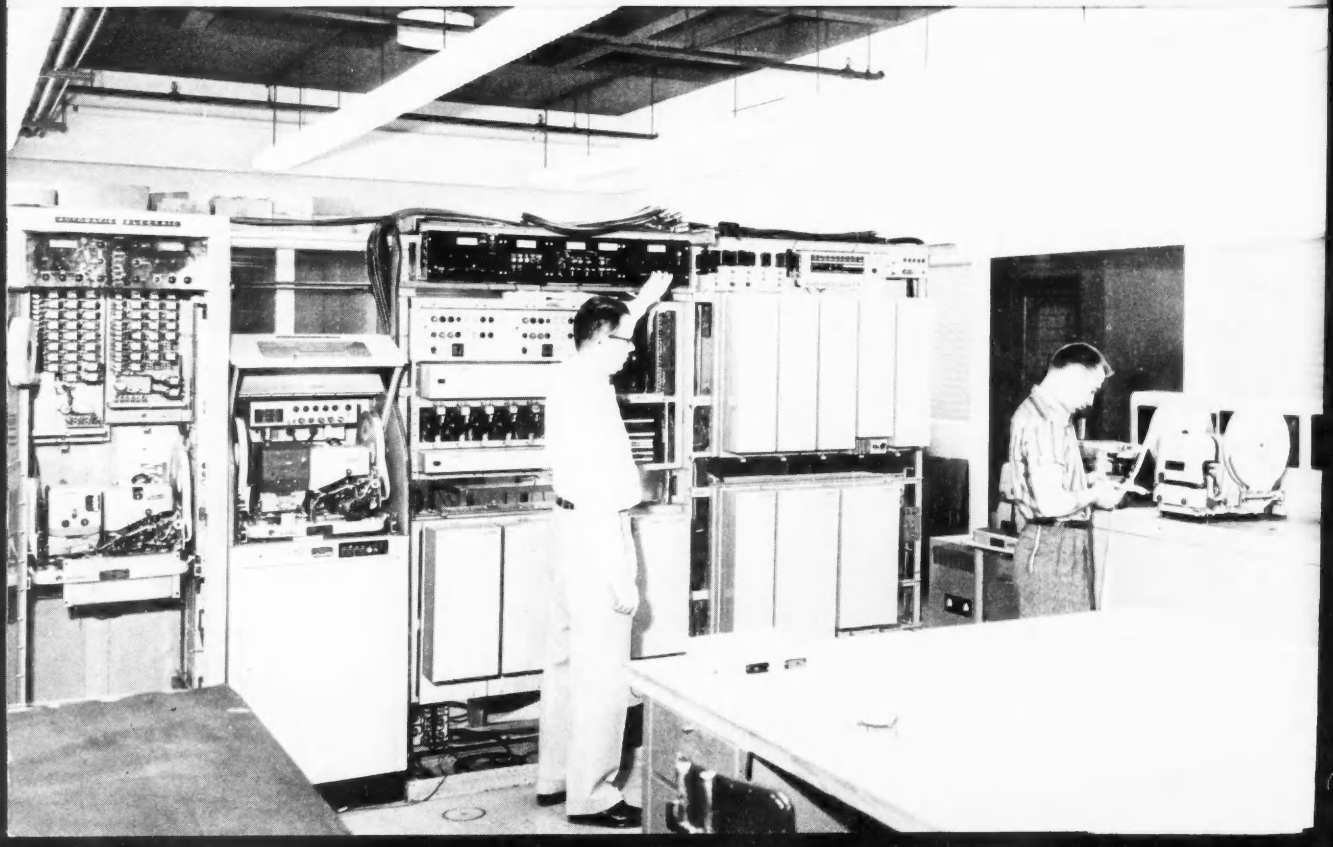
The Mechanical and Electrical Testing section, under the direction of E. Benisek (center of picture, wearing coat) is a service group which performs tests on apparatus of our own design, and other apparatus to be used with it. The specially designed test benches are wired for many types of power, tones, etc.

In the special Life Test Room, shown here, apparatus of current and proposed new designs is constantly being tested under controlled conditions, to determine its potential life in actual service. Continually operating equipment under test (in cabinets along wall at left) makes this a noisy room—in spite of the sound-deadening material on walls and ceiling.



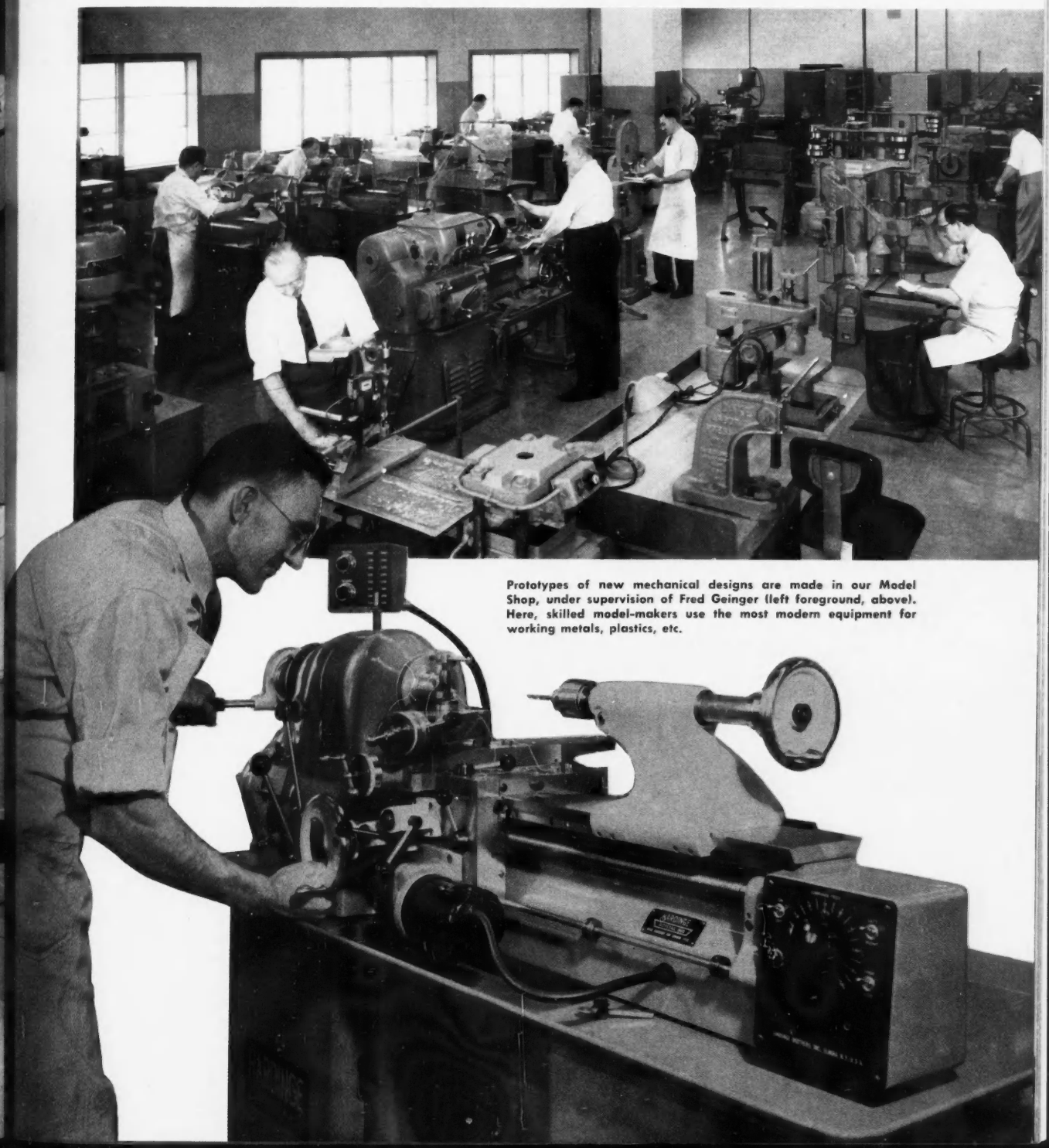
Prototypes of new circuits are assembled and wired by Laboratories' technicians, in readiness for electrical tests. Bjorn Smith, supervisor (standing, at left), is discussing a new design with one of his staff.

Some of the unusually complex equipment used in Teletypewriter Switching is shown here, as it is being put through its paces by engineers of this Laboratories section.

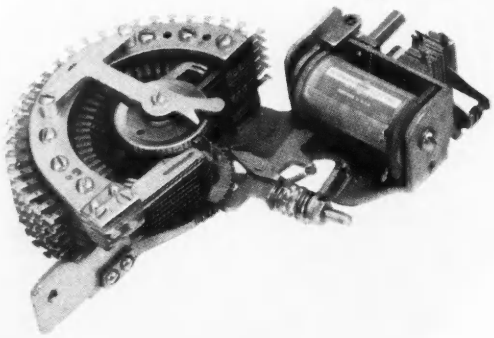


current, busy and other tones, etc.—all supplied from the Laboratories' Power Room.

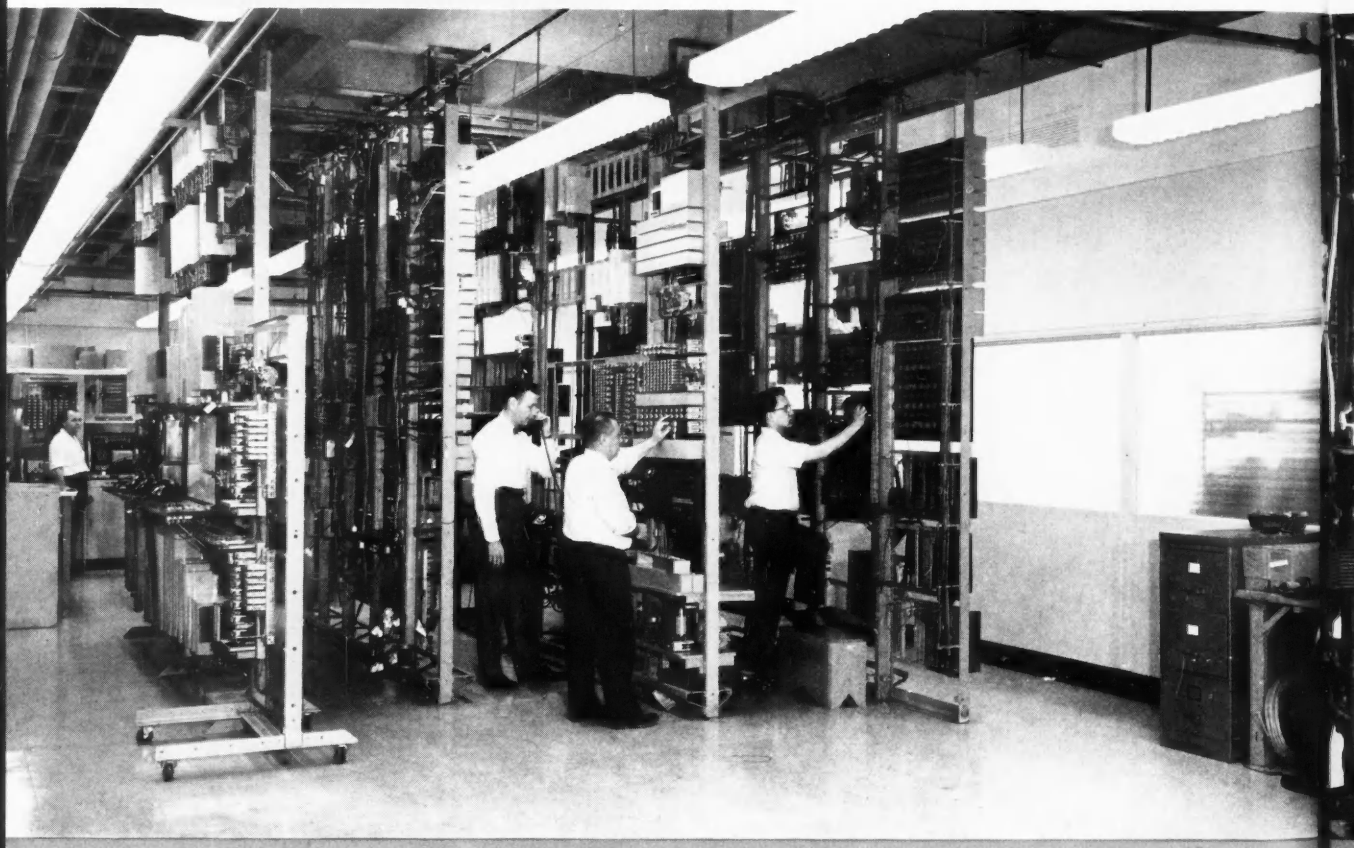
In its role of service to the entire Laboratories, the Product Design department includes a fully equipped Model Shop, staffed with men who can make just about anything the design engineers might desire, as prototypes. And to complete this department, there is a group of Laboratory technicians who can assemble and wire any desired combination of equipment for test.



Prototypes of new mechanical designs are made in our Model Shop, under supervision of Fred Geinger (left foreground, above). Here, skilled model-makers use the most modern equipment for working metals, plastics, etc.



TELEPHONE SWITCHIS



E. J. Glenner, Supervisor of Switching Systems Laboratory, and technicians are performing a consolidated test on a prototype of Toll Ticketing equipment. All new designs of telephone switching devices are put through a complete test in this large laboratory before being released for field service.

H. W. Balzer, M. E. Griffins, and R. B. King, senior project engineers in Telephone Switching Systems, get together to discuss a new SATT circuit.

HISTEMS

"How can this be done?" is a familiar question in this part of the Laboratories—and almost always it gets an answer, even though some of the problems are unbelievably complex! As telephone men have accepted each development in automatic telephony, our engineers have gone ahead with the next advance. Today, we have automatic toll switching systems, multi-frequency signaling, and toll ticketing of station-to-station calls. Tomorrow we'll probably have wide use of four-wire switching, new high standards of transmission, and ticketing of person-to-person calls: our Telephone Switching Systems department has all these developments in mind!

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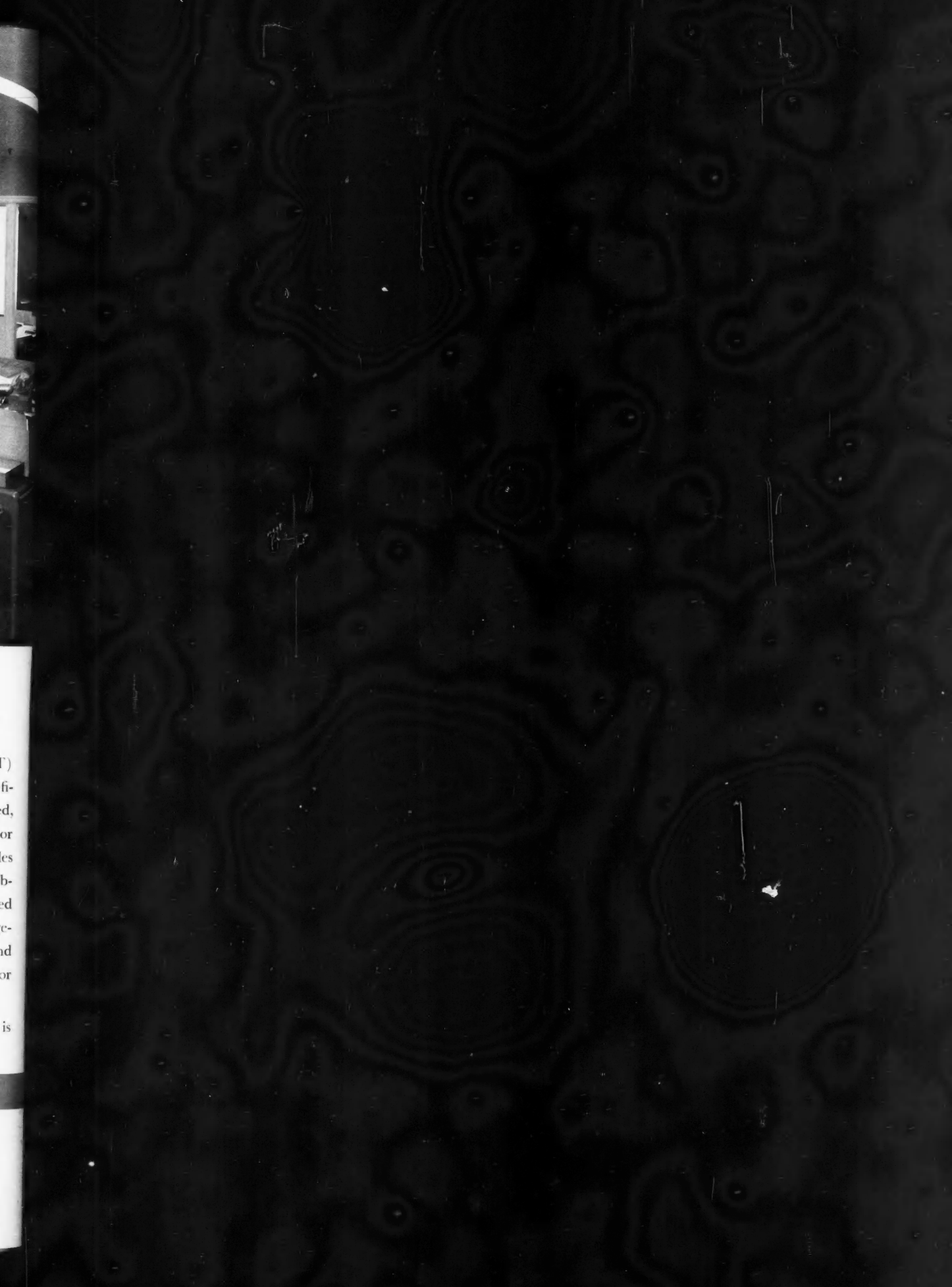
This is the Electro-Mechanical Switching Design section of Telephone Switching Systems. Staff engineers Frank Sikorski (standing, left), Stephan J. Bartha and Robert C. Clark (standing, center rear) and Robert T. Evans (standing, right), team up to develop circuits for Telephone Switching Systems.

At the present time, the designers in our Toll Switching section are working on circuits for manual and for automatic toll boards, intertoll switching trains and control switching toll centers with four-wire switching or two-wire as required, and automatic alternate routing and code translation. They are also designing service-observing equipment and special-service boards (many providing automatic call distribution, to save labor and speed up service).

Another section of this department devotes its full time to the development of Toll Ticketing. Ten per cent of all Independent telephones are already served by Strowger Automatic Toll Ticketing (SATT) equipment, and many additional cutovers are definitely scheduled. Development is being continued, however, in many phases of toll ticketing—systems for short-haul and nationwide service, with access codes or without them, operator-identified systems, subscriber-identified systems, and automatically identified systems for up to 10-party lines—as well as charge-computing systems, automatic ticket-printers, and controls for commercial accounting machines used for toll billing.

Another group of engineers in this department is



called "General Circuits," and handles everything but toll. M-A-X's, C-A-X's, and P-A-B-X's are designed here; also testing gear (including automatic "routiners" that actually *print* trouble records!) and special circuits such as recently developed to permit coin-box customer dialing in multi-office, multi-message unit areas, with a minimum of operator assistance.

Before any new circuit is put to use, it is analyzed by a group of Adjustment Engineers, who make sure that every desirable feature has been included in the circuit, and that it will operate properly. They specify the type and exact characteristics of all relays and other components to be used, and establish tolerances for the necessary adjustments, so the equipment will not be marginal in operation, and will require a minimum of maintenance.

After the Adjustment Engineers finish their work, a model of the new circuit is assembled and set up in our Circuit Testing Laboratory, which is arranged to simulate an actual telephone exchange. Here the equipment operates as it will in the field. To keep pace with modern developments, this Laboratory is constantly being expanded to include SATT systems, new electronic devices, and everything else needed to simulate a modern 10,000-line dial exchange.

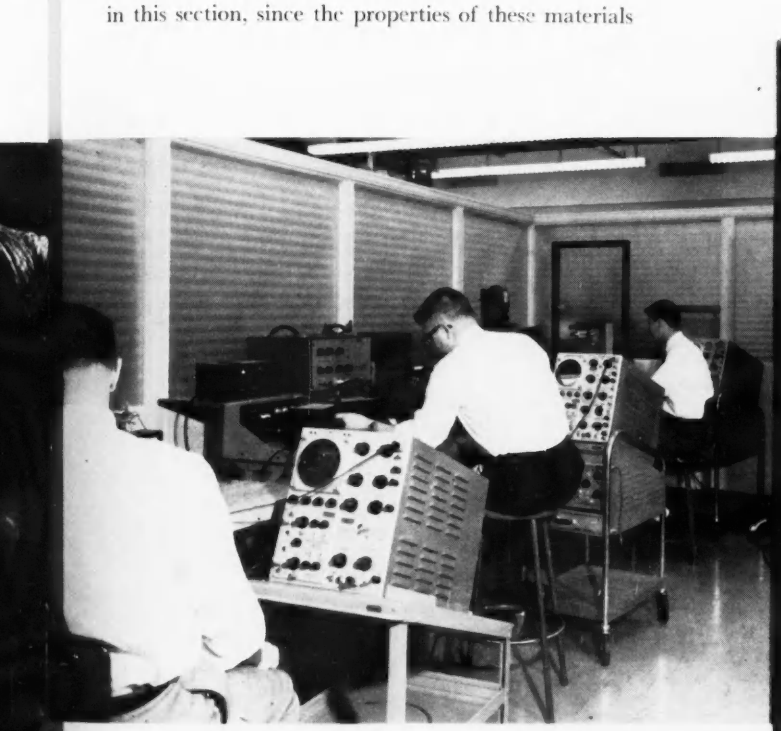
Finally in this department of General Telephone Laboratories, we have a large section called "Circuit Explanations." The engineers in this section study each new circuit and describe its operation in complete detail for the benefit of Automatic's engineering and manufacturing departments and the telephone companies' operating personnel. As a part of their work, these engineers also determine the transmission performance of each circuit, and its power requirements.

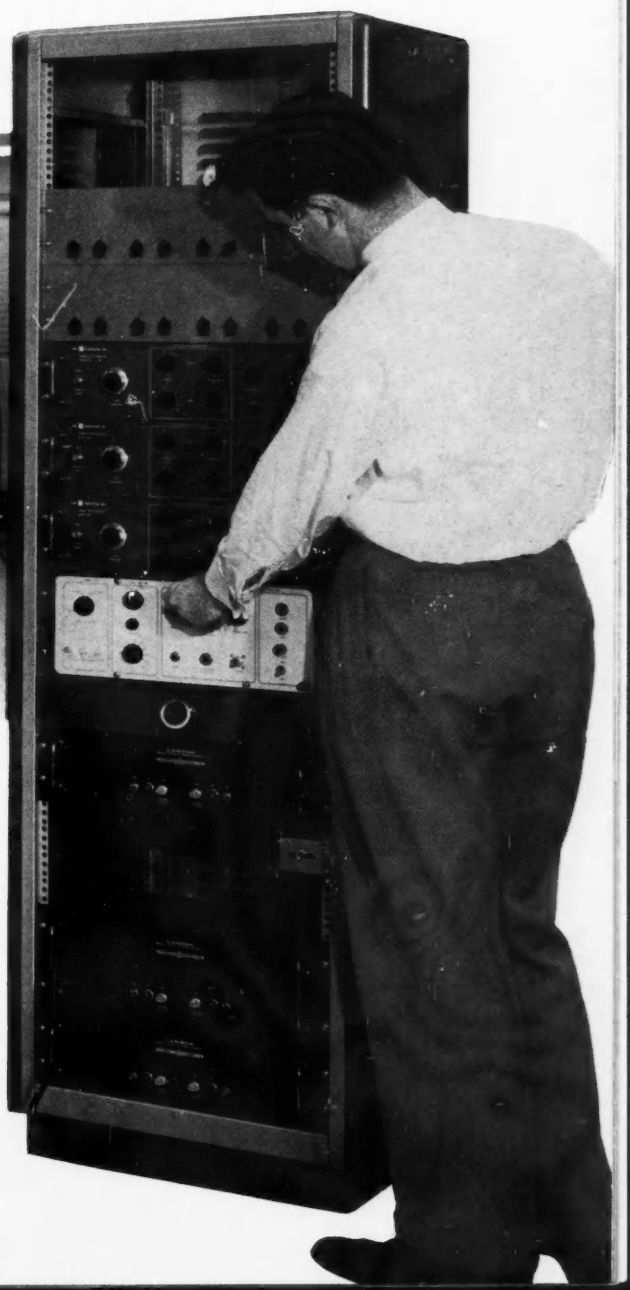
The Toll Ticketing section in Telephone Switching Systems is developing SATT equipment for many new applications. Here, engineer I. V. Coleman tests a new ticketer.

RESEARCH

In this part of our Laboratories the "inquiring spirit" is most important because it is here that we ask questions of *nature!* It may be years before the lessons we learn will be put to practical use—and by the time that occurs, the people in Research will have presented their findings to Product Design and to Telephone Switching Systems, and gone on to new discoveries.

At the present time, this department is directing much of its attention to Electronic Switching in its many phases. One group of engineers, for example, are working in Solid State research—studying semiconductor devices, diodes, and transistors, which are sure to be basic components of electronic switching systems. A high degree of professional skill is required in this section, since the properties of these materials are sensitive to impurities of about one part in 10 million! Another section is investigating other possible components of these future systems; Components engineers are now engaged, for example, in long-range studies of ferrites and their many implications for future telecommunication systems. This section





Here are three members of the Components section in the Research department, checking ferrite cores to be used in a memory system for electronic switching.

Various types of electronic switching systems of limited capacity are built by the Research department, in order to test various possible techniques and materials. Here, John R. Trenchard, engineer, adjusts one of the printed-circuit components on one of these test models.

Engineer Robert M. Patterson, of the Research department's Components section, is adjusting a Pulse Programmer, which is used in testing memory systems.

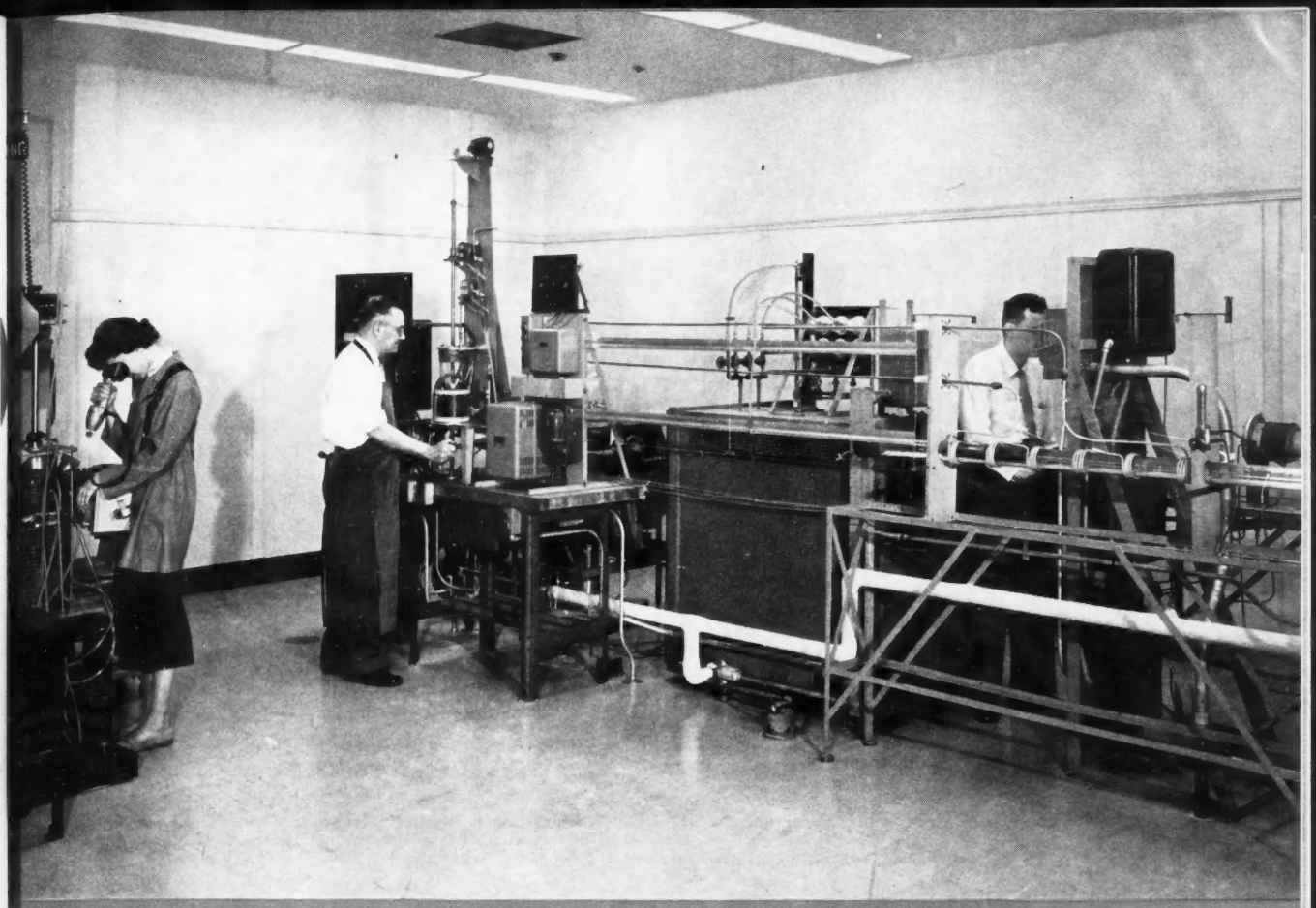
This is the Semi-Conductor Research Laboratory where research is conducted on solid-state devices which are not commercially available, and to develop such devices as will show promise for our switching systems. Here, members of the Laboratory staff are shown (left to right) using an optical pyrometer to observe temperatures during the growing of single-crystal silicon, and adjusting the flow of argon gas in a radio-frequency induction-heated germanium-crystal "puller", and the power to the diffusion furnace. These operations control the growing of crystals (germanium and silicon) and also provide opportunity for study of diffusion techniques, and how these techniques will affect transistors and diodes.

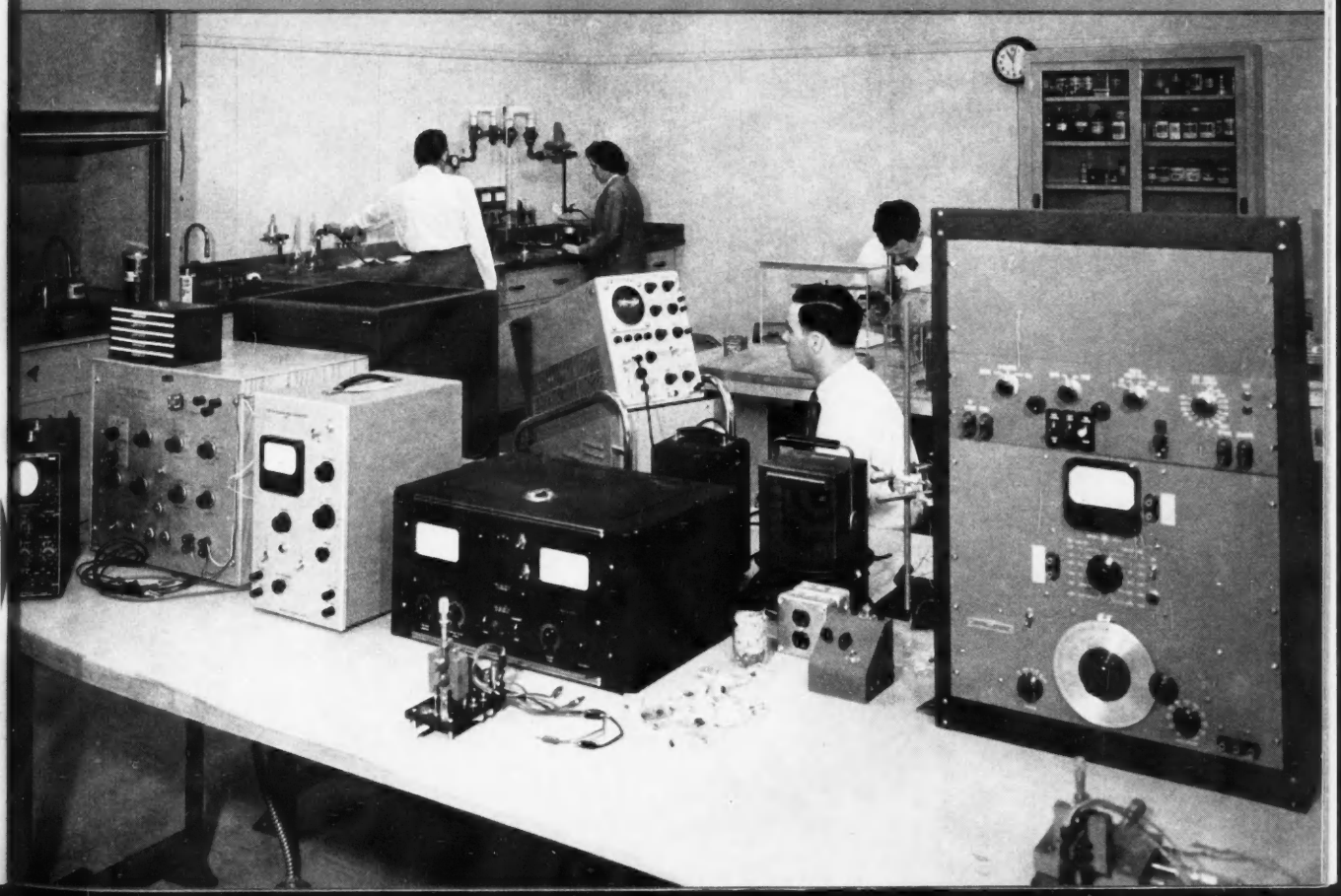
should also be credited with the refinement of, and development of manufacturing facilities for, silicon-carbide varistors to be used as arc-suppressors in Strowger Automatic equipment.

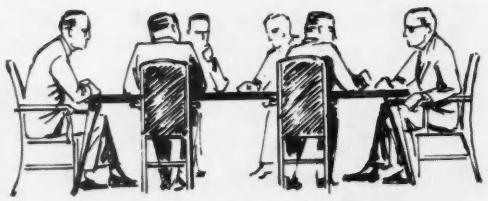
The Mechanical section in the Research department is at present directing its entire efforts to developing the new telephone instrument that will be needed with electronic switching. The magnitude of this problem is evident when you realize that this telephone will require different signaling facilities, different dialing facilities, and a new type of transmitter!

Finally, the Electronic Switching section is studying the switching and transmission problems involved in using various switching systems, the memory devices that might be used, and the power supplies that will be required. Of course, there is also a group of engineers in the Research department who must take into account the overall picture of the development, and carry on a continuing analysis in order to coordinate the efforts of all the other groups.

Another view of the Semi-Conductor Research Laboratory, showing four more members of its staff and a part of the instrumentation needed for this type of research. Such instruments, and the other facilities of the Laboratories, are the "tools' of our engineers in their constant efforts to develop the finest systems and equipment for telecommunications.







ADMINISTRATION

Chief executive officer of General Telephone Laboratories, Inc., is Robert M. Wopat, president of the Laboratories and a vice-president of Automatic Electric Company. Mr. Wopat has been an Independent telephone man ever since he graduated from college; his skill as an engineer, his years of experience in the telephone field, and his proved administrative ability are all brought to bear on the work of the Laboratories.

Mr. Wopat's executive staff includes C. F. Ffolliott, Product Design; Dr. Imre Molnar, Telephone Switching Systems; Dr. D. E. Clark, Research; and C. W. Frank, Facilities and Planning. This last-named section is responsible (in conjunction with representatives of Automatic Electric) for analyzing and recommending development assignments to the other sections. It also is responsible for providing the facilities needed by each of the other sections, when and as they are needed.

As you walk through the new building of General Telephone Laboratories, you can see that the Facilities and Planning people have done a fine job. They would be the first to admit, however, that Laboratories is not the building or its facilities, but the people who use them. Their restless minds make the inquiring spirit of General Telephone Laboratories.

Robert M. Wopat, center, President of General Telephone Laboratories, is discussing a new type of telephone with members of his executive staff—left to right, Dr. Imre Molnar, Telephone Switching Systems; C. W. Frank, Facilities and Planning; Dr. D. E. Clark, Research; and C. F. Ffolliott, Product Design.

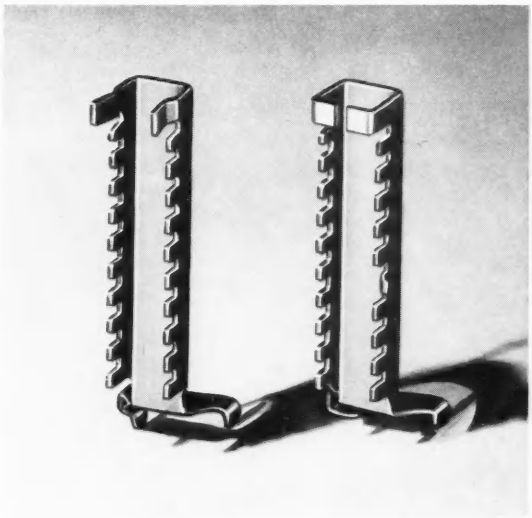
WHAT'S NEW IN GENERAL

"SNAP-ON" NORMAL POST CAM

General Telephone Laboratories has designed a new version of the normal-post cam. The new cam, for use in digit-absorbing selectors, can be clipped onto the normal post without removing the normal-post spring assembly.

Since the new cam (pictured at right) can be so easily installed and removed, the cams supplied on new switches may be removed when the switches are installed, and may then be set aside to be installed quickly when making the transition to 2-5 numbering. This makes it unnecessary to straighten out the marked cams upon installation, and then re-bend them at the time of the transition (this former procedure sometimes resulted in breaking a cam, which then had to be replaced). The new cam will also simplify field replacement of cams in connection with subsequent directory changes or trunking arrangements which require the marking of additional levels or changing of existing marking levels.

The new cam is snapped over the normal post and slid down until it contacts the shaft bearing bracket. It is turned counterclockwise until the tang of the cam clears the edge of the shaft, and is then slid on down the shaft until the short lug contacts the surface of the shaft bearing bracket. A downward force applied over the hooked lug snaps the cam into place.



New Cam Old Style

"QUICK-CHANGE" STROWGER WIPER ASSEMBLY

Wiper blades can now be easily replaced in the field with the new "Quick-Change" Wiper Assembly. This new wiper assembly is particularly advantageous on four-bank Strowger switches where the lower shaft bearing must otherwise be removed to replace the wipers.

To replace a "Quick-Change" Wiper Assembly, the cord clip is removed, by finger pressure, to free the wiper cord. The cord leads are unsoldered from the wiper tips. A collar screw is loosened and the wiper assembly can then be lifted and pulled free of the switch shaft. By removing two screws, the two wiper springs can be removed from the wiper mounting bracket and replaced with new ones.

The new "Quick-Change" Wiper Assembly is now in production and will be used on all Strowger switches in the near future. Telephone people will be pleased to learn about this new development, since it will reduce the cost of changing worn wiper blades in the field. No longer will it be necessary to unsolder all leads to other wipers when making a wiper replacement.

TYPE VMC AUTOMATIC

by E. S. Petersen

Senior Project Engineer, General Telephone Laboratories, Inc.

During the past several years, General Telephone Laboratories has developed a line of Recorder-Announcers which have been widely accepted by telephone companies for time, advertising and weather reporting service. Several of these Recorder-Announcers have been described in previous issues of the Technical Journal.*

With the widespread acceptance of this type of announcing machine, General Telephone Laboratories has developed a new Type VMC (Variable Message Cycle) Recorder-Announcer. This new machine makes it possible to record a message variable in length (twelve seconds to four minutes) and to repeat the message continuously, without appreciable pauses.

**The Automatic Time Announcer*.....*AE TJ 1-51*

Automatic Recorder-Announcers.....*AE TJ 12-54*

Automatic Intercept Service for Telephone Exchanges.....*GT TJ 12-57*

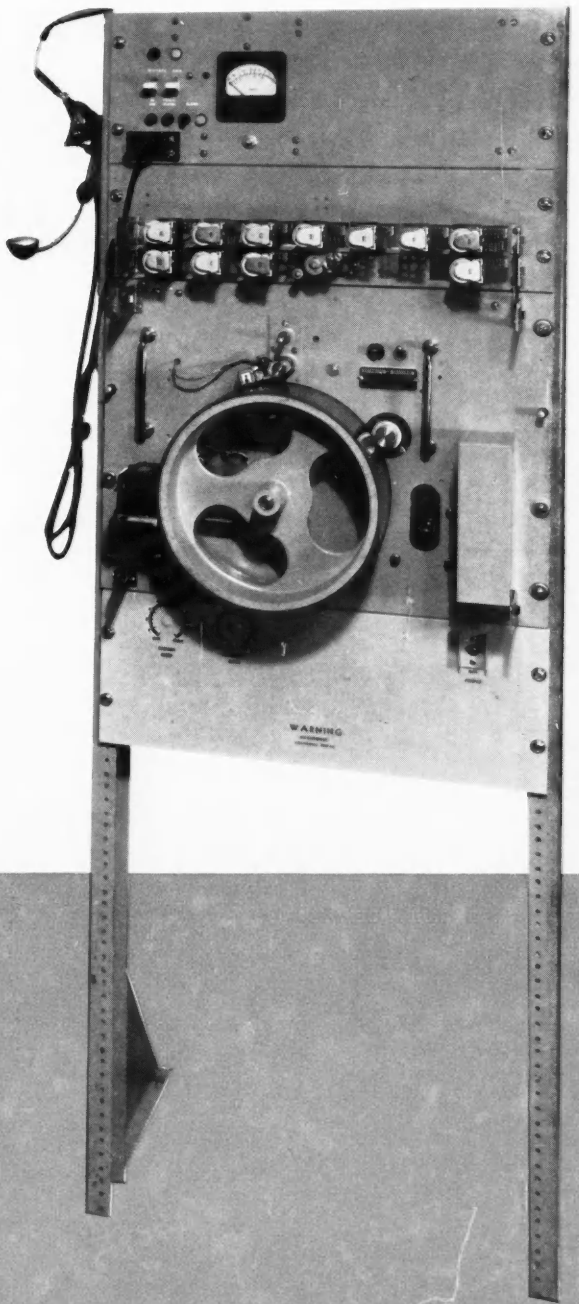
Mobile Remote Control Unit

ATECORDER-ANNOUNCER

The VMC consists of a coupling panel, relay control group, recording-announcing mechanism and amplifier. All units mount on a standard nineteen-inch relay rack in a telephone exchange switchroom.

New operating features have been provided in the VMC. In many cases it may be desirable for the telephone company to limit the maximum permissible recording cycle. This can be done by setting an adjustable bracket to the desired time cycle. The bracket automatically sets a pair of contact springs which lock the time cycle at the desired recording limit. If a longer recording is attempted, the recording head will automatically return to its normal position, and the drum will stop.

In cases where an emergency exists and it is necessary to put a recording on at a moment's notice, or where it is necessary to correct a previous recording, a special "Barge-In" key is provided. By operating



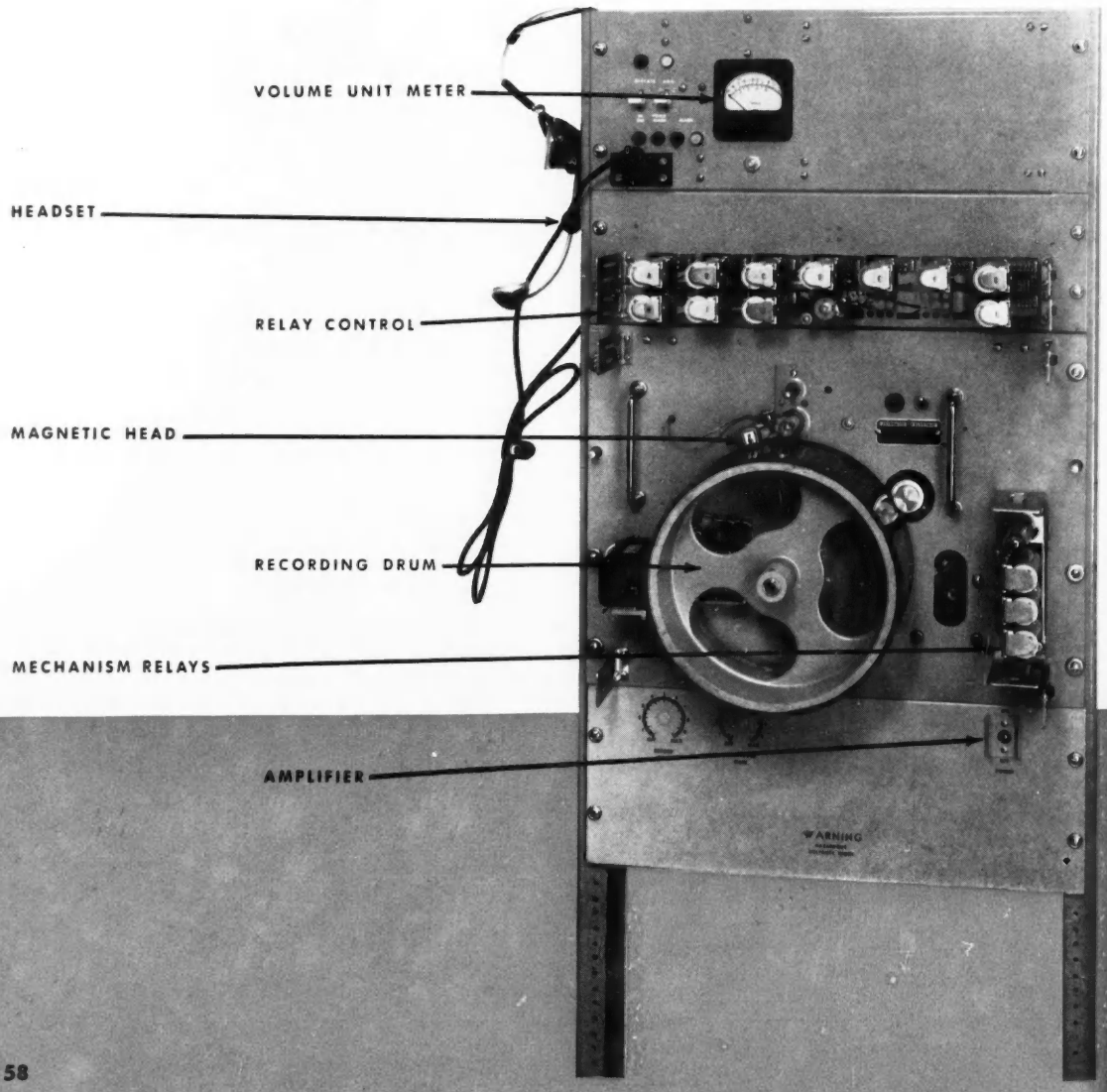
Type VMC Automatic Recorder-Announcer

this key, the recording unit is put into "dictate" position within one turn of the recording drum (six seconds). During recording of the emergency message, the actual recording is closed to the output of the amplifier, and any listening subscriber will hear the message (this is called "live recording"). Special equalization required in magnetic recording is incorporated in the record-playback sections of the amplifier, providing a life-like recording.

Another feature is the "Voice Alarm," which gives an alarm by flashing a lamp, should the output of the amplifier drop during either the recording or playback cycle.

Telephone exchange switchrooms are quite noisy; therefore it becomes necessary at times to make recordings in a quiet location, or at a distant part of the city. To compensate for this, a special (mobile) Remote Control unit is furnished which can be mounted on a desk.

The VMC operates on 105-125 volt, 60 cps AC; current consumption is 70 watts at 115 volts. An external 48-volt exchange battery is required to oper-



ate the recording-announcing switching relay. The Remote Control unit requires 115 volts AC.

To record a message, a Dictate key is operated, which starts a cycle to erase a previous message. When this cycle is completed, a Dictate lamp lights and a new message can be recorded on the recording drum. If, while the operator is dictating the message, the dictate cycle approaches a pre-fixed recording limit, a lamp will light to warn the operator that he must finish the message. After the recording is completed, the Dictate key is released and the stop which limits the movement of the pick-up is automatically set. If the operator wishes to check the recording he operates an Announce key. The machine will announce the recording, reach the adjustable limit, and re-announce until the Announce key is released.

In operation, the recording is made on a magnetic type of rubber band stretched over a drum, revolving at a fixed speed. A "bulk erase" coil, using sixty cycles, is used for erasing previous messages. The recording drum is friction-driven by a smooth-running motor, free of so-called "hunting," to prevent flutter during recording and playback. Click-absorbing networks across all contacts and coils prevent audio clicks in the amplifier.

Maintenance

Maintenance is minimized by using lubrication-packed sealed bearings in all driving units. Occasional lubrication is required on motor bearings, with a special oil (furnished). The recording band must be coated with a special lubricant (furnished) to prevent wear on the recording surface of the "head." No other lubrication is required. The amplifier employs common types of vacuum tubes, and a simple audio amplifier.

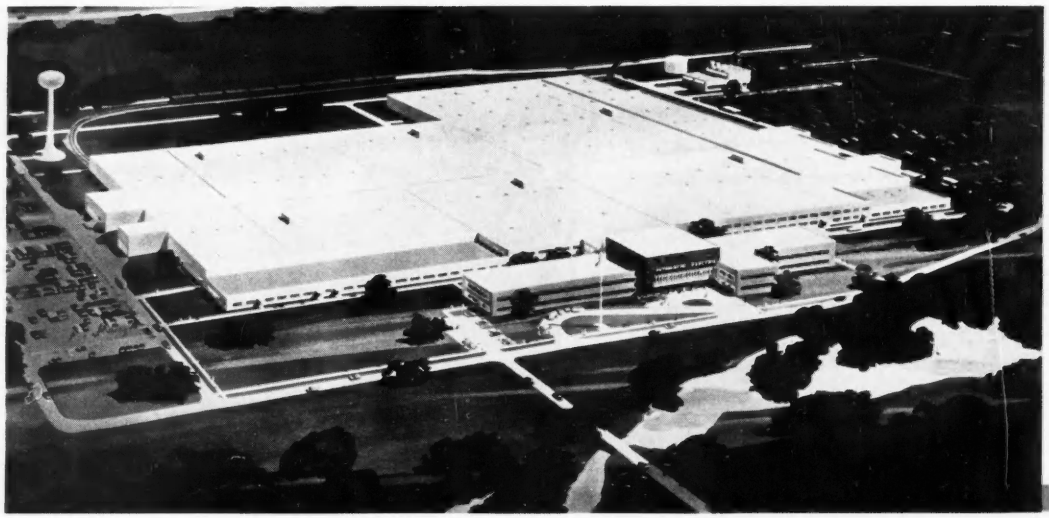
Access Equipment

Holding Bridges or Trunk Circuits can be furnished for either selector or connector terminals.

Conclusion

Just as the Types MCF and SCC Recorder-Announcers have proven to be most appropriate for large and small telephone exchange intercept service, we believe this new Type VMC will meet the needs of telephone companies for main exchange use. P-A-B-X systems can also be supplied with this unit for announcements concerning factory and office personnel.

EDWARD S. PETERSON **came to Automatic Electric in 1920, attended the Training School, and, after a few years in the Inspection Department, entered the Laboratories as a technician. He joined the circuit design section in 1927 and worked on automatic exchanges, remote controlled exchanges, and other special circuit applications. Since 1940 he has been a project engineer on industrial developments, specializing on applications involving electronic devices. Mr. Peterson is a member of the American Institute of Electrical Engineers.**



AN INVITATION!

We have tried to show you some of the important departments and operations of our Laboratory. However, we know that only by a personal visit can you see and learn about all the great things being developed now, and for the future, in the field of telecommunications.

General Telephone Laboratories extends a cordial invitation to come and visit with us. At the same time, if you'd like, we can take you on a tour of Automatic Electric's new plant. This beautiful factory and office building was recently named, by the editors of Factory Management & Maintenance magazine, as one of the ten best plants built in 1957. We're sure you will enjoy your visit!

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